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(54) Heater with PTC and fixed resistance elements

(57) A heater (10) includes a relatively fixed resistance heating element (14) for providing a greater heating rate at lower ambient temperatures and/or high heat transfer environments. The heater further includes a relatively variable resistance heating PTC (positive temperature coefficient) element (23, 25) which has a resistance which increases in response to increased temperature, thereby providing self-regulation by way of reduced heat at increased temperatures. The relatively fixed (14) and variable resistance heating elements (23, 25) are typically provided on opposite sides of a heating pad (12), but may be separated by a dielectric layer (26) and both formed on a single side of the heating pad (12).

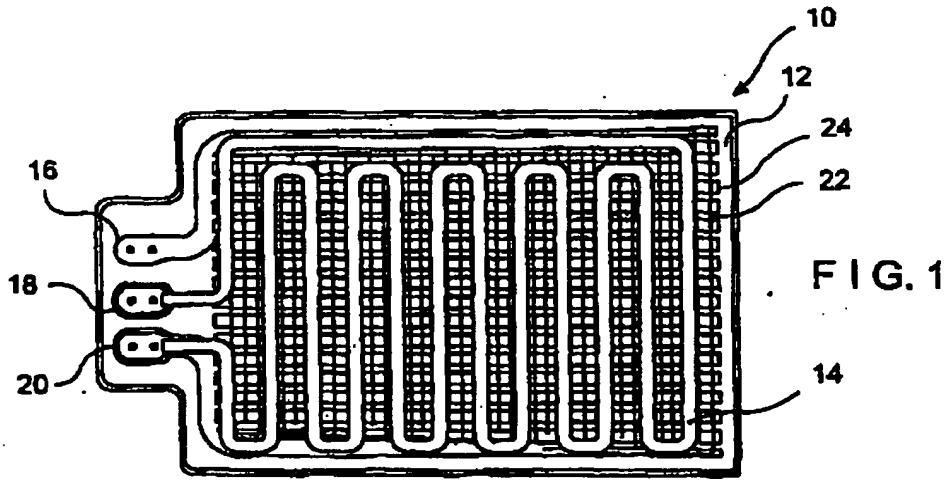

FIG. 1

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Description

[0001] This invention pertains to a heater pad which includes both a PTC (positive temperature coefficient) heater element and a fixed resistance heater element.

[0002] In the prior art, fixed resistance heaters are basic elements. However, in higher ambient temperature or lower heat transfer environments, such heaters can overheat. An example of a dual wattage heater using fixed resistance elements is a KANTHAL 4010 NR 410-1100. PTC (positive temperature coefficient) heaters, such as those disclosed in U.S.-A-4,857,711, have a resistance which increases in response to increasing temperatures. This increased resistance fundamentally reduces the power output in the face of constant input voltage. However, users in several applications prefer a heater with multiple settings (such as "high" and "low") which is typically not available in a PTC heater.

[0003] Preferably a heater pad is provided with a heater pad with a PTC (positive temperature coefficient) heater printed on a first side of the heater pad and a secondary fixed resistance heater screen printed on the second side of the heater pad. Terminal connections are made by an eyelet acting as a through hole to create, a switchable three-point connection to be used for high and low power setting. Altexnatively, a multi-layer single sided screen printed heater can be used with a dielectric layer to separate the two individual heater elements.

[0004] According to this invention a heater includes:

a heating pad providing a substrate;
a relatively fixed resistance heating element; and
a relatively variable resistance heating element with an inherent increasing resistance in response to increasing temperatures; and

wherein said relatively fixed resistance heating element and said relatively variable resistance heating element are supported by said heating pad.

[0005] A particular embodiment in accordance with this invention will now be described with reference to the accompanying drawings; in which:-

Figure 1 is a plan view of the heater of the present invention;
Figure 2 is a plan view of the PTC conductor layer of the present invention;
Figure 3 is a plan view of the PTC thermistor layer of the present invention;
Figure 4 is a plan view of the fixed resistance layer of the present invention; and
Figure 5 is a plan view of the dielectric layer which can be used in the alternative embodiment of the present invention to separate the PTC layer and the fixed resistance layer.

[0006] Referring now to the drawings in detail wherein like numerals refer to like elements throughout the several views, one sees that Figure 1 is a plan view of dual heater 10. Dual heater 10 includes heater pad 12 which acts as a substrate upon which subsequent layers comprising the heating elements and possibly a dielectric layer are superimposed, as will be explained hereinbelow. Fixed resistance serpentine heater element 14 (also see Figure 4) is typically screen printed onto a first side of heater pad 12 and is in electrical communication through high power positive terminal 18 and common ground terminal 20 thereby forming an electrical circuit therethrough.

[0007] Figure 2 is a plan view of PTC conductor layer 22 which is in electrical communication with low power positive terminal 16 and common ground terminal 20 and which further includes parallel rows of conductor elements 23. PTC conductor layer 22 provides an electrical connection to PTC thermistor layer 24 as shown in Figure 3. PTC conductor layer 22 is immediately adjacent to PTC thermistor layer 24 to provide such an electrical connection. The variable resistance as a function of temperature is provided by the inherent characteristics of the PTC thermistor layer 24 in which the thermistor heating elements 25 are provided in parallel rows which contact the parallel rows of conductor elements 23. Conductor elements 23 are typical perpendicular to thermistor heating elements 25. Fixed resistance serpentine heater element 14 is separated from the combination of the PTC conductor layer 22 and PTC thermistor layer 24 by either the heater pad 12 (that is, fixed resistance serpentine heater element 14 is screen printed on the first side of the heater pad 12, and variable resistance PTC conductor and thermistor layers 22, 24 are formed on a second side of heater pad 12) or by dielectric layer 26 illustrated in Figure 5 (that is, fixed resistance serpentine heater element 14 and the PTC conductor and thermistor layers 22, 24 are formed on a single side of heater pad 12 with dielectric layer 26 separating heater element 14 from the combination of PTC conductor and thermistor layers 22, 24).

[0008] Typically a switchable three point connection (not shown) is used with terminals 16, 18, 20 to provide for high and low power settings.

[0009] In the low power configuration, an electrical circuit is formed between low power positive terminal 16 and ground terminal 20 thereby providing an electrical circuit through PTC conductor layer 22 and PTC thermistor layer 24. This provides a low power, self-regulating heat source for use in high ambient temperature or low heat transfer situations.

[0010] In the high power configuration, an electric circuit is formed between high power positive terminal 18 and ground terminal 20 thereby providing an electrical circuit through the fixed resistance serpentine heater element 14. This provides a high power, relatively non-regulating heat source for low ambient temperatures (such as below 32° F 0°C.) or high heat transfer situations.

Claims

1. A heater including:

   a heating pad (12) providing a substrate;
   a relatively fixed resistance heating element (14); and
   a relatively variable resistance heating element (23, 25) with an inherent increasing resistance in response to increasing temperatures; and
   wherein said relatively fixed resistance heating element (14) and said relatively variable resistance heating element (23, 25) are supported by said heating pad (12).

2. A heater according to claim 1, wherein said heating pad (12), said relatively fixed resistance heating element (14) and said relatively variable resistance heating element (23, 25) are substantially coplanar with each other.

3. A heater according to claim 1 or 2, wherein said relatively fixed resistance heating element (14) is in electrical communication with a first positive terminal (16) and a common ground terminal (20) and said relatively variable resistance heating element (23, 25) is in electrical communication with a second positive terminal (18) and said common ground terminal (20).

4. A heater according to any one of the preceding claims, wherein said relatively variable resistance heating element includes a conductor layer (23) and a thermistor layer (25).

5. A heater according to claim 4, wherein said conductor layer includes parallel rows of conductor elements (23) and said thermistor layer includes parallel rows (25) of thermistor elements, said parallel rows of conductor elements (23) being in electrical contact with and perpendicular to said parallel rows (25) of thermistor elements.

6. A heater according to any one of the preceding claims, wherein said relatively fixed resistance heating element (14) is screen printed onto a first side of said heating pad (12).

7. A heater according to claim 6, wherein said relatively variable resistance heating element (23, 25) is formed on a second side of said heating pad (12).

8. A heater according to claim 6, wherein said relatively fixed resistance heating element (14) is separated from said relatively variable resistance heating element (23, 25) by a dielectric layer (26) and one of said relatively fixed resistance heating element (14) and said relatively variable resistance heating element (23, 25) is joined to said heating pad (12).

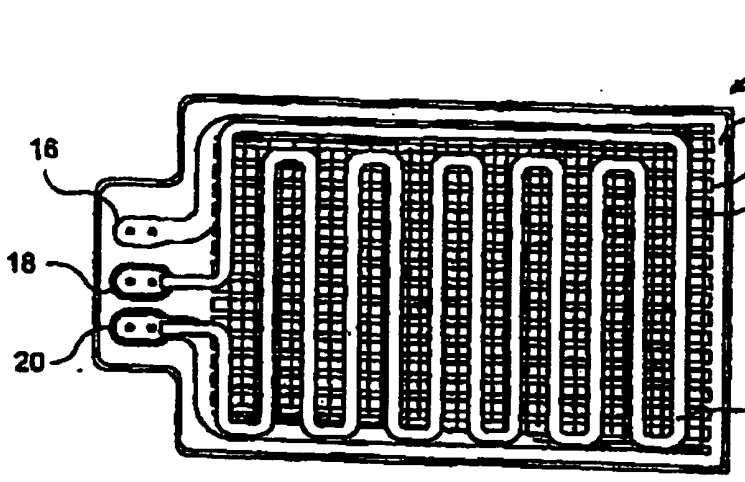

FIG. 1

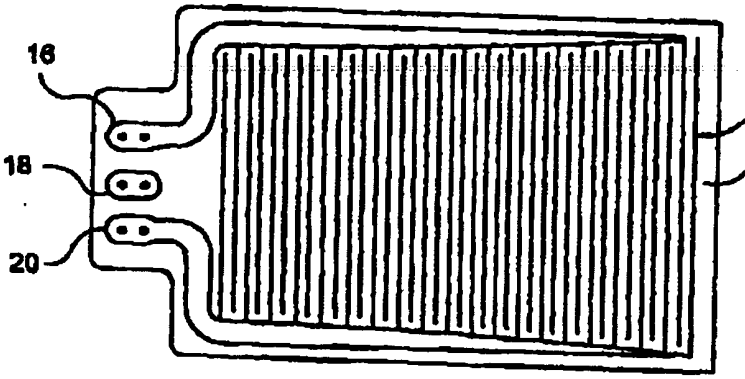

FIG. 2

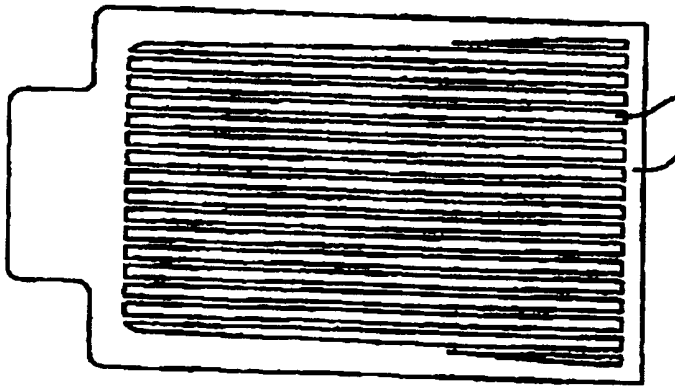

FIG. 3

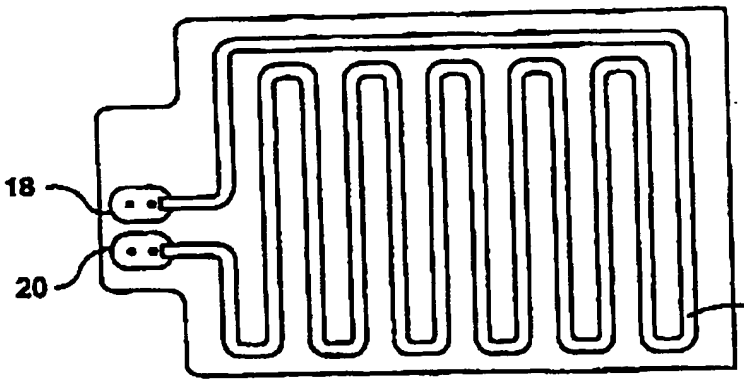

FIG. 4

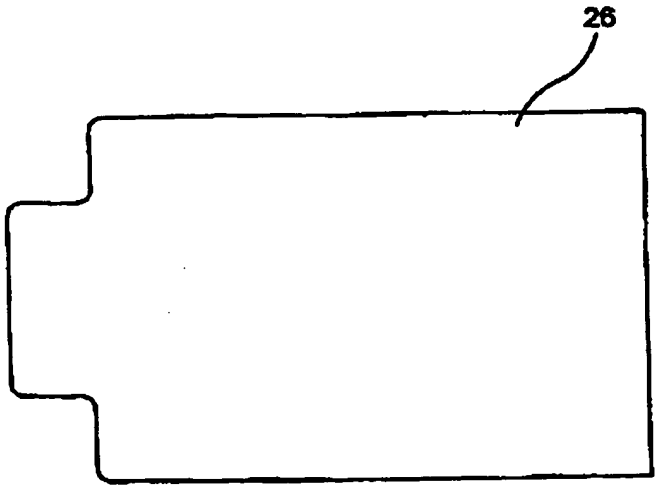

FIG. 5